Foreign AGRICULTURE

REVIEW OF FOREIGN FARM POLICY, PRODUCTION, AND TRADE

VOLUME 6, NO. 8 AUGUST 1942

IN THIS ISSUE

CONTINENTAL EUROPE'S PRE-WAR FOOD BALANCE

YERBA MATÉ

SUED MONTHLY BY THE UNITED STATES DEPARTMENT OF AGRICULTURE

FICE OF FOREIGN AGRICULTURAL RELATIONS • WASHINGTON, D. C.

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Foreign Agriculture is issued monthly by the Office of Foreign Agricultural Relations of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by direction of the Secretary of Agriculture as administrative information required for proper transaction of the public business, with the approval of the Director of the Budget. Copies may also be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., 10 cents a copy, or by subscription at the rate of $1.00 per year, domestic; $1.60 per year, foreign.

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EP 9 '42

CONTINENTAL EUROPE'S PRE-WAR FOOD BALANCE . . . . .

By J. H. Richter*

A detailed statistical analysis of continental Europe's pre-war balance of foods and feeds is an indispensable part of the background material needed for any quantitative evaluation of the continent's wartime food situation or its possible post-war requirements. Such an analysis indicates that over a period of years before the outbreak of war in 1939 the continent produced roughly 90 percent of its caloric food requirements. In protein and carbohydrate the continent was 95 percent self-sufficient; in fat, only 73 percent.

Slightly over three-fourths of the continental calorie intake was derived from foodstuffs of vegetable origin, and somewhat less than one-fourth from foodstuffs of animal origin. The continent doubtless has a certain reserve potential of food self-sufficiency. Should a lower rate of population growth prevail and a moderate post-war increase in agricultural production over pre-war levels be achieved, even a small dietary shift from foods of animal origin to foods of vegetable origin could in the long run substantially reduce the continent's normal dependence on outside supplies. On the other hand, even moderate improvement in the composition of the continental diet over pre-war standards could have important expansive repercussions upon the world's markets for agricultural products.

INTRODUCTION

For an appraisal and interpretation of the food situation in continental Europe under wartime conditions and of continental post-war food requirements it is necessary to have a clear-cut picture of the degree to which domestic production covered the continent's food needs before the outbreak of the war. It is particularly important to know the interrelationships between food and feed supplies and the bases of self-sufficiency for the individual components of the continental diet. These interrelationships and their quantitative significance cannot be grasped from simple statistics of how much of the individual products was produced and imported. Only an allocation and evaluation of imported feedstuffs in terms of the foodstuffs produced from them can show the true extent to which the continent depended upon supplies from overseas.

Such composite and comprehensive calculation of continental Europe's pre-war food deficit also gives a statistical clue to appraising the significance of actual or potential export surpluses of nearby extracontinental areas in relation to European needs. The calculation likewise makes it possible to gage the repercussions that changes in agricultural production in Europe or nearby supply areas or changes in the

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continental diet will have upon the world's agricultural markets. And it should furthermore be possible to determine, for each potential or prospective change, not only the general direction of such repercussions but also the extent to which individual products will be affected and the train of secondary shifts in requirements that will follow in their wake.

The present statistical analysis considers individual countries in their 1937 boundaries and is made for the continent, excluding the Soviet Union. The latter's contribution to the food and feed supply of Western Europe in the thirties was mainly wheat and barley, although some rye and oats were also exported. A small butter export persisted through the thirties, whereas the previously important exportation of eggs, as a result of the collectivization of the peasant farms and its effect upon livestock, ceased altogether.

The decade from 1929 to 1939 was a period of generally increasing production in European agriculture, although it is not clear whether or to what extent the increase in food output on the continent exceeded the reduced growth of population. In the case of some commodities and countries a curtailment of domestic consumption doubtless played a part in the reduction of dependence on foreign supplies. Expansion in agricultural production was stimulated by the trend of economic policy toward increased emphasis on agriculture in the industrial countries. The economic crisis of 1929-30 and the ensuing depression created conditions that made governmental action imperative. Though most governments generally hesitated to take bold and unorthodox steps to halt or reverse the downward trend of employment, production, and living standards, they did not shrink from vigorous measures to expand production in one field: agriculture. There were many reasons - political and economic - for this, and in Germany and Italy there was the added urge to increase all-round self-sufficiency for military reasons. It was in that period that Germany expanded its production of wheat, feed crops, and milk by a substantial margin, reduced the dependence of its livestock on foreign feed supplies, and consequently raised its food self-sufficiency from 73 percent in 1929 to 83 percent in 1937. Italy, in the "battle of wheat," by 1937 had succeeded in raising production of its most important feedstuff by about one-fourth of the 6 million metric tons produced in 1927-31. Corn in the same period increased from over 2 million to about 3 million tons. France in its European boundaries, previously a heavy wheat importer, in some years of the thirties became a surplus producer of wheat. Breadgrain production in Poland, Czechoslovakia, the Baltic countries, Sweden, and Finland was considerably expanded and in some areas yielded surpluses for export to other regions. Spain before the outbreak of the civil war in 1936 had raised wheat production from under 4 million tons in 1927-31 to near 5 million tons in 1932-35. At the other end of the Mediterranean, Greece through expansion of acreage and improvement in yields also achieved a substantial increase in the output of wheat. The Danubian countries, partly under contractual purchase guaranties from Germany, Italy, Austria, and Czechoslovakia, expanded wheat, corn and livestock, oilseed, and fruit production.

Austria, whose balance of payments always was heavily burdened with the importation of foodstuffs and feedstuffs, also made forceful strides in raising agricultural output. Grain, potato, sugar-beet, dairy, and meat production was substantially increased, and import deficits were reduced.

The basis for the increase in agricultural output on the continent was largely an intensification of production, though expansion or shifts in acreages also played a part. Increased use and more rational application of fertilizers, improved mechanization, better crop rotations, shifts toward higher yielding crops, improved seeds,

TABLE 1.—*Estimated continental European self-sufficiency in foodstuffs between 1936 and 1938*

COUNTRY	DEGREE OF SELF-SUFFICIENCY	COUNTRY	DEGREE OF SELF-SUFFICIENCY
	Percent		*Percent*
Deficit countries:		Surplus countries:	
Norway [1]	43	Estonia [1]	102
Belgium [2]	51	Denmark [1]	103
Switzerland [3]	52	Poland [10]	105
Netherlands [1]	67	Latvia [1]	106
Finland [4]	78 (70)	Yugoslavia [1]	106
Greece [5]	75	Bulgaria [1]	109
Austria [1]	75	Lithuania [1]	110
Germany [6]	83	Rumania [1]	110
France [7]	85	Hungary [1]	121
Czechoslovakia [1]	95		
Sweden [1]	91	Continental Europe: [11]	
Portugal [1]	94	Deficit countries	84 (80)
Italy [8]	94 (83)	Surplus countries	108
Spain [9]	99 (75)	Total	91 (88)

[1] Estimate given by Institut für Konjunkturforschung. WAGEMANN, ERNST, ed. DIE SELBSTVERSORGUNG MIT LEBENSMITTELN IN DER WELT. Berlin Inst. f. Konjunkturforsch. Wchnber. 12 (5): [21]-24. 1939.

[2] As per source given in footnote 1. The percentage estimated by the Institut de Recherches Economiques is 50. See BAUDHUIN, FERNAND. L'ALIMENTATION DE LA BELGIQUE, LES DONNEES DU PROBLEME EN CAS DE BLOCUS. Louvain Univ. Catholique, Inst. des Sci. Écon. Bul. 10: [375]-388. 1939.

[3] As per SCHWEIZERISCHES BAUERNSEKRETARIAT. STATISTISCHE ERHEBUNGEN UND SCHÄTZUNGEN AUF DEM GEBIETE DER LANDWIRTSCHAFT. V. 17. 1940. The Institut für Konjunkturforschung estimated Switzerland's degree of self-sufficiency at only 47 percent.

[4] The higher figure of 78 for about 1937 as per source quoted in footnote 1; the lower figure of 70 estimated by the Office of Foreign Agricultural Relations considering the loss of Karelia in the Finno-Russian war of 1939-40 and the then reported population transfers.

[5] Estimated by the Office of Foreign Agricultural Relations. The Institut für Konjunkturforschung estimate was 80, which seems high.

[6] Estimated by the Office of Foreign Agricultural Relations. The Institut für Konjunkturforschung estimate was 83, which seems low.

[7] Estimated by the Office of Foreign Agricultural Relations. The Institut für Konjunkturforschung estimate was 100, which seems high.

[8] The estimate of 94 as per BARBERI, BENEDETTO. INDAGINE STATISTICA SULLE DISPONIBILITÀ ALIMENTARI DELLA POPOLAZIONE ITALIANA DAL 1922 AL 1937. [Italy] Ist. Cent. di Statis., Ann. di Statis., Ser. VII, v. 3, pp. 1-98. 1939. Barberi (pp. 68-69) states that per capita food consumption in 1934-37 had declined compared with that in the economically more prosperous years 1926-29 by 12 percent, on a calorie basis. It may be estimated, therefore, that if consumption had been maintained at 1926-29 per capita levels and yet production had been as high as in 1934-37, Italy's food self-sufficiency would have reached only 83 percent, the percentage given in parentheses. The assumption of domestic production at the increased 1934-37 levels, if per capita food consumption were to reach 1926-29, is perhaps disputable. It might be argued that such a level of food consumption could only have been sustained in conditions - levels of industrial employment and production, foreign trade, prices - not conducive to increased, or maintenance of increased, agricultural production. In view of this probability, the statistically indicated percentage of 83 (which otherwise would seem somewhat low) appears to be less objectionable.

[9] The higher percentage of 99, for a year before the civil war in Spain, as per source given in footnote 1. The lower percentage of 75, estimated by the Office of Foreign Agricultural Relations, is based upon normal pre-war per capita consumption but reduced post-civil-war agricultural production in Spain.

[10] Roughly estimated by the Office of Foreign Agricultural Relations.

[11] Estimated by the Office of Foreign Agricultural Relations as the averages of the country percentages, weighted by population numbers as well as national levels of calorie consumption. Weighting by population numbers alone gives approximately the same results. Weighting by population numbers as well as national calorie levels was considered necessary in order that the surpluses of some countries be made strictly commensurate, in absolute quantities, with the deficits of other countries. Obviously, given two countries with the same population numbers, a self-sufficiency deficit of, say, 10 percent in the one country will just be covered by a self-sufficiency surplus of 10 percent in the other country only if average calorie consumption is the same in both countries. Weighting by calorie intake in addition to population numbers reduces the deficit and surplus percentages to a comparable basis.

Two independent checks confirm the total continental European self-sufficiency percentage thus calculated. The one is an independent estimate by the Office of Foreign Agricultural Relations of the composition and self-sufficiency of total continental consumption by food groups. The second is an estimate, also by the Office of Foreign Agricultural Relations, made on the basis of total continental food and feed imports in terms of food calories and total continental calorie consumption. See tables 3 and 4 for these estimates.

better feeding practices, and improvement of livestock - all these were factors in the movement toward intensification, in some regions supplementary to larger input of labor, in others more than offsetting a decline in the agricultural labor supply.

It is true that in some countries the increased self-sufficiency along certain agricultural lines was partly a shift toward greater dependence in other lines or reduced export production of other farm products. Partly, too, dependence on import supplies was shifted from agricultural products to fertilizers, agricultural machinery, and motor fuel, not all of which could be supplied on an intracontinental basis. Basically, before the outbreak of war, continental Europe was or, with full utilization of its resources, could have been self-sufficient in nitrogenous and potash fertilizers. Only one-fourth, or at best one-third, of the phosphoric acid from commercial fertilizer consumed on the continent was covered by intracontinental production of basic slag and phosphate rock. However, the export surpluses of nearby North Africa and the Kola Peninsula fully equaled the net continental deficit in phosphoric acid. In considering continental fertilizer deficits it must also be kept in mind that commercial fertilizer supplies only a fraction of all plant nutrients returned to the soil, with farmyard manure providing the larger part.

FOOD SELF-SUFFICIENCY BY COUNTRIES

A number of national research organizations in Europe have made composite calculations of the degrees of self-sufficiency in foodstuffs for individual European countries. The common denominator mostly used is the fuel value of the foodstuffs consumed as the relatively least unsatisfactory basis on which such calculations can be made. Feedstuffs have been included in the calculation of national dependence on foreign supplies by evaluating their contribution to the national consumption of food in terms of the food calories ultimately produced from them.

Table 1 gives self-sufficiency percentages for each of the major continental European countries as estimated for a recent pre-war year. Complete self-sufficiency is denoted by 100; percentages below 100 indicate the existing food deficit, whereas the excess of the surplus countries over 100 indicates their food and feed surplus, in terms of food calories, as a percentage of their total food consumption.

As may be seen from the table, degrees of self-sufficiency in continental Europe ranged from a deficit of 57 percent in Norway to a surplus of 21 percent in Hungary. The general deficit region is west of a line drawn from the Gulf of Trieste through Vienna, Danzig, and on north along the Baltic coast through the Gulf of Finland to Petsamo. The only country outside this territory with a substantial deficit is Greece, and the only country inside this territory with a surplus is Denmark. All countries east of the line - with the noted exception of Greece - are surplus producers. The heaviest deficits are in northwestern Europe - Norway, the Low Countries, and Switzerland - whereas Germany, France, and Italy are more than four-fifths self-sufficient. Import dependence of the Iberian Peninsula, where the standard of nutrition is low, normally is still less.

In continental Europe with a 1942 population of about 355 million, about 255 million people lived in deficit countries. Roughly 44 million were in countries with a normal pre-war self-sufficiency of or below 75 percent. Countries with a normal pre-war food self-sufficiency of from 80 to 90 percent (Italy included) comprise about 156 million people, and deficit countries with a normal percentage of over 90 (Italy excluded) comprise about 55 million people. The population in the true surplus countries is about 100 million. For continental Europe as a whole, food self-sufficiency on a calorie basis amounted to about 90 percent. It should be noted that these degrees of

TABLE 2.—*Production, foreign trade, and utilization of grain in continental Europe*[1], *averages 1933-36 and 1936-38*

WHEAT (INCLUDING SPELT) AND RYE

COUNTRY GROUP	AVERAGE 1933-36						AVERAGE 1936-38					
	PRODUCTION	NET IMPORTS (+) OR NET EXPORTS (-)	UTILIZATION	PERCENTAGE NET IMPORTS ARE OF UTILIZATION	PERCENTAGE NET EXPORTS ARE OF PRODUCTION	PERCENTAGE NET EXPORTS OF SURPLUS COUNTRIES ARE OF NET IMPORTS OF DEFICIT COUNTRIES	PRODUCTION	NET IMPORTS (+) OR NET EXPORTS (-)	UTILIZATION	PERCENTAGE NET IMPORTS ARE OF UTILIZATION	PERCENTAGE NET EXPORTS ARE OF PRODUCTION	PERCENTAGE NET EXPORTS OF SURPLUS COUNTRIES ARE OF NET IMPORTS OF DEFICIT COUNTRIES
	1,000 metric tons	*1,000 metric tons*	*1,000 metric tons*	*Percent*	*Percent*	*Percent*	*1,000 metric tons*	*1,000 metric tons*	*1,000 metric tons*	*Percent*	*Percent*	*Percent*
Deficit countries	44,353	+5,087	49,440	10	-	-	42,323	+6,216	48,539	13	-	-
Surplus countries:												
Danube Basin	10,414	-1,015	9,399	-	10	20	12,628	-1,927	10,701	-	15	31
Others	9,935	-816	9,119	-	8	16	9,678	-509	9,169	-	5	8
Total	20,349	-1,831	18,518	-	9	36	22,306	-2,436	19,870	-	11	39
Total continent	64,702	+3,256	67,958	5	-	-	64,629	+3,780	68,409	6	-	-

BARLEY, OATS, CORN, AND MASLIN

Deficit countries	33,153	+6,531	39,684	16	-	-	33,846	+7,350	41,196	18	-	-
Surplus countries:												
Danube Basin	16,473	-1,711	14,762	-	10	26	17,738	-1,442	16,296	-	8	19
Others	8,329	-480	7,849	-	6	7	8,366	-494	7,872	-	6	7
Total	24,802	-2,191	22,611	-	9	33	26,104	-1,936	24,168	-	7	26
Total continent	57,955	+4,340	62,295	7	-	-	59,950	+5,414	65,364	8	-	-

ALL GRAINS (SUMMARY)

Deficit countries	77,506	+11,618	89,124	13	-	-	76,169	+13,566	89,735	15	-	-
Surplus countries:												
Danube Basin	26,887	-2,726	24,161	-	10	23	30,366	-3,369	26,997	-	11	25
Others	18,264	-1,296	16,968	-	7	11	18,044	-1,003	17,041	-	6	7
Total	45,151	-4,022	41,129	-	9	34	48,410	-4,372	44,038	-	9	32
Total continent	122,657	+7,596	130,253	6	-	-	124,579	+9,194	133,773	7	-	-

[1] Excluding Soviet Union; individual countries in 1937 boundaries.

national and continental self-sufficiency are conditioned by general economic, institutional, and social circumstances as much as by natural factors, and there is no intrinsic stability in them. Given continuity in social and economic developments, a once-established degree of self-sufficiency is apt to change only slowly. On the other hand, a drastic break in such continuity, through war or comprehensive economic reorganization, might result in more rapid changes in food self-sufficiency.

SELF-SUFFICIENCY BY FOOD GROUPS

The Office of Foreign Agricultural Relations has cross-checked the estimates of composite food self-sufficiency in individual countries by an all-continent calculation of food consumption by groups of foodstuffs and of percentages of "true" or net self-sufficiency in these various groups - that is to say, percentages that take into consideration not only direct imports of foodstuffs but also imports of feedstuffs in terms of the food calories produced therefrom.

It appears that the outstanding continental deficit was in fats and oils. Over a number of years before the outbreak of war the continent as a whole produced less than three-fourths of its total requirements of fats and oils for food. Moreover, since a proportion of this production was based upon imported feedstuffs, the "true" degree of self-sufficiency was only about 60 percent. If the catch by the whaling fleets of continental countries (Norway, Germany) were to be regarded not as domestic production but as imports, continental self-sufficiency for all fats and oils would appear to have been only about 55 percent. Central Europe, France, and Belgium were the main deficit regions for fats. Within its total fat requirement continental Europe in recent pre-war years was self-sufficient with respect to animal fats; in fact, there was a substantial continental surplus of butter, largely in Denmark and the Netherlands, which these countries used to export to United Kingdom markets. This surplus, however, was produced from imported supplies of feed concentrates.

Except for small imports of whale oil and lard, the pre-war deficit in fats and oils was almost exclusively met by importation from overseas of oilseeds for oil extraction in continental crushing mills. These imports at the same time yielded large quantities of oil cake - a very valuable protein concentrate, especially for dairy cattle.

With regard to consumption of fresh milk the continent was fully self-sufficient. The existing export surplus of about 6 percent of total continental production of cheese and of about 5 percent of eggs on the whole was produced from imported feedstuffs. There was also an export surplus in meat - about 1 percent of continental production; small imports of beef from overseas were more than balanced by a net export of bacon and ham, notably to the United Kingdom. The export trade to England in bacon and ham, as well as in eggs, was largely done by Denmark, followed by the Netherlands, Poland, Sweden, and Lithuania. Imports of pork, hogs and cattle by continental deficit countries (Germany, Austria, Czechoslovakia, Belgium, Greece, Italy) were largely covered by surpluses from Denmark and eastern and southeastern Europe. Eggs for the deficit countries came from the same regions, the Low Countries, Finland and Sweden. The most important net exporters of cheese were the Netherlands, Italy, Switzerland, and Denmark.

True continental self-sufficiency in meat, despite the gross export surplus of about 100,000 metric tons, was only about 86 percent. It appears that of total estimated continental production of meat of 11,000,000 metric tons over 1,600,000 tons were produced from imported feedstuffs. The true dependence of meat production on foreign supplies was greater than is apparent from a superficial glance at the feed

TABLE 3.—*Pre-war composition of food consumption, and summary calculation of self-sufficiency[1] in continental Europe*

FOODSTUFFS	DOMESTIC PRODUCTION OF FOOD FROM-			DIRECT NET IMPORTS (+) OR NET EXPORTS (-)[2]	TOTAL DOMESTIC FOOD CONSUMPTION	PERCENTAGE OF CONSUMPTION PRODUCED DOMESTICALLY FROM-		FUEL VALUE PER TON OF FOOD[3]	DOMESTIC FOOD CONSUMPTION		INDEX OF PRODUCTION FROM DOMESTIC RESOURCES[5]
	DOMESTIC RESOURCES	IMPORTED FEEDSTUFFS[2]	ALL SOURCES			ALL SOURCES	DOMESTIC RESOURCES		FUEL VALUE	PERCENTAGE OF TOTAL[4]	
	1,000 metric tons	*1,000 metric tons*	*1,000 metric tons*	*1,000 metric tons*	*1,000 metric tons*	*Percent*	*Percent*	*1,000 calories*	*Billion calories*	*Percent*	
Breadstuffs and cereals (including rice) for food, in terms of flour	41,050	-	41,050	+3,050	44,100	93.1	93.1	3,500	154,355	44.7	41.6
Potatoes for food	40,000	-	40,000	-	40,000	100.0	100.0	800	32,000	9.3	9.3
Sugar for food	5,500	-	5,500	+500	6,000	91.7	91.7	4,000	24,000	6.9	6.3
Legumes	-	-	-	-	-	-	100.0	-	7,940	2.3	2.3
Fruits and nuts, fresh vegetables, and cocoa	-	-	-	-	-	-	95.0	-	12,092	3.5	3.3
Meats	9,375	[6]1,625	11,000	-100	10,900	100.9	86.0	[7]2,000	[8]19,620	5.7	4.9
Fish	-	-	-	-	2,600	-	100.0	1,300	[6]3,040	0.9	0.9
If only coastal fishing and fresh-water catch considered as domestic production	-	-	-	-	(2,600)	-	(50.0)	(1,300)	[8](3,040)	(0.9)	(0.45)
Eggs	2,100	100	2,200	-100	2,100	104.8	100.0	1,370	2,877	0.8	0.8
Fats and oils for food:											
Butter	1,000	700	1,700	-200	1,500	113.3	66.7	7,850	11,775	3.4	2.3
Lard	1,100	(6)	1,100	+20	1,120	98.2	98.2	9,260	10,371	3.0	3.0
Marine oils	260	-	260	+70	330	78.8	78.8	9,000	2,970	0.8	0.6
Vegetable oils	1,000	-	1,000	+1,700	2,700	37.0	37.0	9,300	25,110	7.3	2.7
Total fats and oils	3,360	700	4,060	+1,590	5,650	71.9	59.5	8,890	50,226	14.5	8.6
Total if marine oils counted as imports	(3,100)	(700)	(3,800)	+(1,850)	(5,650)	(67.3)	(54.9)	(8,890)	(50,226)	(14.5)	(8.0)
Fresh milk	-	-	-	-	-	-	100.0	650	20,730	6.0	6.0
Cheese	1,600	100	1,700	-100	1,600	106.3	100.0	3,000	4,800	1.4	1.4
Alcohol	-	-	-	-	-	-	100.0	-	13,820	4.0	4.0
Total	-	-	-	-	-	-	-	-	345,500	100.0	[9]89.4 [9](88.4)
Foodstuffs of vegetable origin	-	-	-	-	-	-	-	-	-	78.0	-
Foodstuffs of animal origin	-	-	-	-	-	-	-	-	-	22.0	-

[1] Estimates by the Office of Foreign Agricultural Relations for about 1936; continental Europe excluding Soviet Union; individual countries in 1937 boundaries. See also table 4.

[2] See corresponding calculations in table 4.

[3] Estimated as continental European averages by the Office of Foreign Agricultural Relations on the basis of the food-value tables given by F. J. König, checked against other European sources as well as the factors given by Charlotte Chatfield and Georgian Adams and the Research Department of H. J. Heinz Company, Pittsburgh, Pa. See KÖNIG, J. NAHRUNG UND ERNÄHRUNG DES MENSCHEN; KURZES LEHRBUCH. 213 pp. Berlin. 1926; CHATFIELD, CHARLOTTE, and ADAMS, GEORGIAN. PROXIMATE COMPOSITION OF AMERICAN FOOD MATERIALS. U. S. Dept. Cir. 549, 91 pp. 1940; and H. J. HEINZ COMPANY. NUTRITIONAL CHARTS FOR MEDICAL AND OTHER SPECIALISTS. Ed. 10, 39 pp., illus. 1941.

[4] May also serve as index of total food consumption.

[5] Column 11 multiplied by column 8 and divided by 100.

[6] Lard produced from imported feed conveniently included under meat. The final results of this table are not thereby significantly affected.

[7] Allowance made for bone.

[8] Excluding 10 percent waste.

[9] Percentage of food self-sufficiency for continental Europe (about 1936).

balance. Relatively more food calories were produced from the average composition of imported feedstuffs than from the average composition of domestically produced feeds.

The continent of Europe was self-sufficient in fish supplies, though if only coastal fishing and the fresh-water catch were to be considered as domestic production pre-war continental dependence on imported fish was considerable.

With regard to feed grains, continental Europe in recent pre-war years depended upon supplies from abroad to the extent of about 8 percent of total utilization (table 2). The term "feed grains" as here employed includes corn, which in the producing areas of southern and southeastern Europe is used for human food as well. The deficit in feed grains was not a large item in the total continental feed supply. But in some countries, such as the Netherlands, Belgium, and Norway, the share of imports in total feeding, of grains at least, was large - one-half to three-quarters in the Low Countries and upwards of one-quarter in Norway. In Germany, on the other hand, only about 10 percent of the total quantities of grain fed was made up by imports.

For the commercial hog industry in northwestern Europe the imports of feed grains - corn and barley - constituted an integral part of its feed basis. Poultry and egg production - which yield a surplus - in these districts was also partly dependent on imported grain. Net exports from the Danubian surplus countries amounted to about one-fourth of the feed-grain imports of the continental deficit regions, whereas exports by other continental exporting countries amounted to about 7 percent of those imports. As far as feed grains are concerned, the Soviet Union in the thirties exported varying, but on the whole not very large, quantities of barley and small quantities of oats and corn. These Russian exports probably amounted to not more than 7 percent of the net continental deficit in feed grains.

Of an estimated 4,700,000 metric tons of continental European feed consumption of oil cake about 4,000,000 metric tons, or 85 percent, were imported, mainly as the cake equivalent of imported oilseeds. While a relatively modest item in the feed supply of the continental livestock industry, these quantities were of considerable importance to intensive dairy farming in the Scandinavian countries, the Low Countries, and parts of Germany and France.

Apart from these sectors of the continental livestock industry - that is to say, hogs and pork products and poultry and eggs in northwestern and parts of Central Europe, as well as dairy production in the intensive dairy-farming districts of Scandinavia, the Low Countries, parts of Central Europe, and of France - continental European livestock production was maintained on a domestic-feed basis.

With respect to bread grain the continent in recent pre-war years produced from 93 to 95 percent of its total requirements, as may be seen from table 2. In potatoes the continent was fully self-sufficient, but about half of the continent's consumption of rice was usually filled by imports from overseas.

Before the outbreak of war Germany, Austria, Czechoslovakia, and Poland, taken together, were virtually self-sufficient in bread grains. The Iberian Peninsula before the civil war in Spain was also practically self-sufficient. Italy and France needed relatively small imports of bread grains, with France importing largely from its North African possessions.

On the other hand, the Finno-Scandian countries (in recent years with the exception of Sweden), the Low Countries, Switzerland, and Greece, depended to a considerable extent on imported grain for their bread supply - from one-third of total human consumption in Denmark to over four-fifths in Norway. This dependence was partly qualitative; for example, in Denmark and the Netherlands wheat for bread was imported,

whereas domestic wheat and rye were largely fed to livestock. The Danubian countries, on the other hand, normally produced substantial export surpluses, most of which were shipped to continental deficit regions. Measured in terms of the net imports of bread grain into continental deficit countries, net exports by the Danubian countries amounted to about one-fourth and exports by other continental surplus countries to about one-eighth. The Soviet Union in the 1930's exported greatly varying quantities of wheat and some rye - which amounted to from 20 to 25 percent of the net continental deficit in bread grains.

Rice is grown mainly in Italy and Spain, which are at the same time Europe's largest consumers and only surplus producers of rice. France was the continent's largest importer, with a considerable share of the imported rice used for feeding. In no country did the consumption of rice exceed 5 percent of total human consumption of farinaceous foods.

With respect to sugar the continent had to cover about 8 percent of total consumption by imports from overseas. France, Portugal, Switzerland, Belgium, and the Netherlands, as well as Finland and Norway, were relatively large importers of sugar. Germany is basically self-sufficient. Czechoslovakia, Poland, and Hungary - in some recent years also Denmark - were exporters of sugar. Between two-fifths and one-half of the sugar import requirements of continental deficit countries have been supplied by continental exporting countries.

Continental Europe produced practically all of its requirements in fresh vegetables and dry legumes. Imports of fresh apples, bananas, and dried fruits from overseas in normal pre-war years were considerable but in the total continental balance for fruits appear to have been of little importance. With normal pre-war production of citrus fruits in Spain and Italy, the continent had a statistical export surplus of oranges and lemons.

From the detailed calculations of the continental food and feed balance by groups of foodstuffs as given in table 3 the Office of Foreign Agricultural Relations has estimated continental European self-sufficiency for the three principal food constituents. Food self-sufficiency in protein before the war amounted roughly to 95 percent, for both vegetable and animal protein. The same percentage holds good for carbohydrate. Continental self-sufficiency in fat was only about 73 percent: for animal fat alone it was 88 percent and for vegetable fat, 43 percent.

TOTAL CONTINENTAL SELF-SUFFICIENCY

As may be seen from table 3, for the continent as a whole and for all foodstuffs taken together self-sufficiency on a calorie basis may be estimated at roughly 90 percent, or the same percentage calculated in table 1. The degree of continental self-sufficiency was about the same in both foodstuffs of vegetable origin (89) and of animal origin (90).

An alternative calculation of continental Europe's pre-war food self-sufficiency is given in table 4. It is based upon independent estimates of average national levels of calorie intake in continental countries and upon net imports of foodstuffs and feedstuffs in terms of food calories. The table also shows the conversion of feedstuff imports into food equivalents and in this respect amplifies table 3. Only partly based on identical original data, the over-all approach of table 4 is a cross check on the results of the food-group approach in table 3. This check calculation yields the same continental self-sufficiency percentage as the previous two calculations; namely, about 90.

TABLE 4.—*Alternative calculation of pre-war food self-sufficiency*[1] *in continental Europe*

FEEDSTUFFS	NET IMPORTS OF FEEDSTUFFS					FOOD EQUIVALENT OF ALL IMPORTED FEEDSTUFFS				
	VOLUME	DIGESTIBLE PROTEIN		STARCH EQUIVALENT		MEAT AND EGGS	MILK (INTERMEDIATE PRODUCTION)	FROM INTERMEDIATE MILK PRODUCTION		
		PERCENT[2]	VOLUME	PERCENT[2]	VOLUME			BUTTER	CHEESE	SKIM MILK
	1,000 tons	*Percent*	*1,000 tons*	*Percent*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*	*1,000 tons*
Feed grains[3]	4,800	6-7/8	330	79	3,800	[4] 700	-	-	-	-
Rice for feed	[5] 350	5-1/2	20	82	290					
Bran from imported bread grains	[5] 900	10	90	45	400	[6] 90	[6] 925			
Oilcake (mainly cake equivalent from imported oilseeds)	[8] 4,000	30	1,200	70	2,800	[9] 935	[9] 19,775	700	100	[7] 16,800
Total	10,050	-	1,640	-	7,290	1,725	-	700	100	-
Net exports of livestock products	-	-	-	-	-	200	-	200	100	-
Net indirect imports of foodstuff	-	-	-	-	-	1,525	-	500	0	-

FOODSTUFFS	VOLUME	FUEL VALUE PER METRIC TON	TOTAL FUEL VALUE OF IMPORTED FOODSTUFFS	
			AMOUNT	PERCENTAGE OF TOTAL CONSUMPTION
	1,000 tons	*1,000 calories*	*Billion calories*	*Percent*
Net direct imports:				
Wheat and rye in terms of flour	2,600	3,500	9,100	-
Rice for food (milled equivalent)	450	3,500	1,575	-
Sugar (refined equivalent)	500	4,000	2,000	-
Fats and oils (including edible oil equivalent of imported oilseeds)	[10] 1,790	9,300	16,650	-
Fruits and nuts, vegetables, cocoa	-	-	600	-
Total net direct imports	-	-	29,925	-
Net indirect imports:				
Meat and eggs	1,525	[11] 2,000	2,750	-
Butter	500	7,850	3,925	-
Total net indirect imports	-	-	6,675	-
Total net imports of foodstuff	-	-	36,600	10.6
Fuel value of continental food production	-	-	308,900	89.4
Fuel value of continental food consumption	-	-	[12] 345,500	100.0

See footnotes on page 309.

The calculated degree of continental European food self-sufficiency in terms of fuel value is simply the percentage that total calorie production for food is of total calorie consumption. As has been stated before, domestic production of feedstuffs as well as imports had to be evaluated, for purposes of this calculation, in terms of the food calories of the livestock products ultimately produced from them. If food self-sufficiency were to be understood as the actual level of production in relation to that volume of output that would be required to produce domestically all of the continent's food needs of unchanged composition, the calculation would have to be different.[1] It would further be modified by a separate consideration of the feed requirements of draft animals and other overhead feed needs that do not directly enter into a statistical conversion of feedstuffs into livestock products for food.

A comprehensive balance sheet of this sort, which is given in table 5, does not differ as to the final result obtained. Total continental crop production for food

[1] For a more detailed explanation of the two methods see footnote 2 to table 5.

TABLE 4.—Continued

[1] Estimates by the Office of Foreign Agricultural Relations for about 1936; continental Europe excluding Soviet Union; individual countries in 1937 boundaries. See also table 3. Food self-sufficiency calculation based on straight average of average continental imports and exports for the 4 years 1933-36 and the 3 years 1936-38, thus giving slightly higher weight to the 1936-38 period when imports of bread grains, fats and oils, sugar, and feedstuffs were somewhat raised by the accumulation of emergency reserves in a number of European countries, notably Germany. This method has been chosen in order to guard against an overestimation of representative pre-war continental self-sufficiency on the basis of the rather high levels of domestic production attained in 1936-38.

[2] Percentages based upon KELLNER, O. GRUNDZÜGE DER FÜTTERUNGSLEHRE. Ed. 8, rev. and enl. by G. Fingerling, 223 pp. Berlin. 1929.

[3] Barley 620,000 metric tons, oats 420,000, corn 3,760,000, total 4,800,000. Percentage of digestible protein for barley 8.0, for oats 7.2, and for corn 6.6; weighted average, 6-7/8. Percentage of starch equivalent for barley 72, for oats 60, and for corn 82; weighted average 79.

[4] Calculated on a pork and protein basis; 500 tons of protein equal 1,000 tons of meat and eggs.

[5] Roughly estimated.

[6] Calculated on a protein basis, under the assumption that one-half of the 90,000 metric tons of imported bran protein went into meat and egg production, and the other half into milk production. The calculation is as follows: 45,000 tons of protein, at 500 tons per 1,000 tons of pork, equal about 90,000 tons of meat and eggs; 45,000 tons of protein, at 50 grams per liter of milk of a specific gravity of about 1.03, equal about 925,000 metric tons of milk.

[7] Used for feed. See footnote 9.

[8] Calculations based upon data given by the International Institute of Agriculture would indicate a figure of only 2,700 to 3,100. Calculations by H. v. d. Decken for 1936-38 gave 4,700. See INTERNATIONAL INSTITUTE OF AGRICULTURE. INTERNATIONAL YEARBOOK OF AGRICULTURAL STATISTICS. 1936-38; INTERNATIONAL INSTITUTE OF AGRICULTURE. OILS AND FATS: PRODUCTION AND INTERNATIONAL TRADE. Internatl. Inst. Agr. Studies of Princ. Agr. Prod. on World Market, Nos. 4 and 5. 1939; and DECKEN, HANS VON DER. DIE INTENSIVIERUNG DER EUROPÄISCHEN LANDWIRTSCHAFT. Berlin Inst. f. Konjunkturforsch., Vrtljh. z. Wirtschaftsforsch. 15: 94-119. 1941.

[9] Calculated on a protein basis under the assumption that 80 percent of the 1,200,000 metric tons of imported oil-cake proteins went into milk production, 10 percent into pork, and 10 percent into other meats. The calculation is as follows: 960,000 metric tons of protein, at 50 grams per liter of milk of a specific gravity of about 1.03, equal about 19,775,000 tons of whole milk; 120,000 tons of protein, at 500 tons per 1,000 tons of pork, equal 240,000 tons of meat, and 120,000 tons of protein, at 1,600 tons per 1,000 tons of other meat, equal 75,000 tons of other meat, or a total of 315,000 tons of meat. From the 19,775,000 tons of whole milk, 16,800,000 tons of skim milk as a byproduct of butter was produced, with a digestible-protein content of 3.8 percent, or 640,000 tons of protein equivalent. 25 percent, or 160,000 tons, of this protein produced 320,000 tons of pork (see above conversion factor), and 75 percent, or 480,000 tons, produced 300,000 tons of other meat (see above), or a total of 620,000 tons of meat from skim milk and a total of 935,000 tons of meat altogether.

[10] For composition of this item see table 3. Does not cover the butter exports, which were taken account of above.

[11] Less 10 percent for waste.

[12] Calculated on the basis of an estimated 1936 population of 343 million and a weighted average continental calorie consumption of 2,760 per person per day.

and feed may be estimated at 900 trillion calories. Of this total, 110 trillion would have to be deducted for seed and all kinds of waste and loss, leaving 790 trillion. Of these, 240 trillion may be counted as directly used for food, whereas the remaining 550 trillion went into feed production. The balance of feed utilization would show about 100 trillion calories used for draft animals and 450 trillion for the production of livestock products for food.

Total food production in terms of calories ultimately consumed by human beings would then consist of the 240 trillion directly used as food plus 64 trillion - the equivalent of 450 trillion feed calories converted into animal food, with a loss of six-sevenths of the calories fed. Adding 5 trillion calories for fish and marine oils not agriculturally produced gives a total human consumption from domestic resources of 309 trillion calories. Imports of direct food calories amounted to 30 trillion; to these must be added the imports of livestock products or feedstuffs, not in terms of the 6½ trillion food calories ultimately obtained from them but in terms of the calories of feedstuffs that domestic agriculture would have to produce to eliminate these imports. Thus the 6½ trillion convert into about 45 trillion of crop calories, which,

with the 30 trillion directly imported as food calories, gives a total of 75 trillion. Adding 25 percent for seed, loss, and waste and for additional draft animals required gives 95 trillion calories by which pre-war continental crop production would have had to be raised in order that the continent, with preservation of the composition of its food supplies, could have been made completely independent of imports of foodstuffs and feedstuffs. Therefore, of a total of 995 trillion calories of crop production needed to produce all of continental Europe's food requirements of pre-war composition, 900 trillion were produced domestically - which gives again a self-sufficiency percentage of, roughly, 90.

TABLE 5.—*Production versus consumption approach in the calculation of continental European food self-sufficiency*

PRODUCTION APPROACH	FUEL VALUE	CONSUMPTION APPROACH	FROM VEGETABLE SOURCES	FROM ANIMAL SOURCES	TOTAL FUEL VALUE
	1,000 billion calories		*1,000 billion calories*	*1,000 billion calories*	*1,000 billion calories*
Actual agricultural production of foodstuffs and feedstuffs	900	Consumption of domestic vegetable foodstuffs	240		
Seed, losses, and waste	110	Consumption of animal foodstuffs produced from domestic feed[1]		64	
Feed for draft animals	100	Consumption of domestic production of fish and fish oils		5	
Net available	690				
Direct vegetable foodstuffs	240				
Feedstuffs for conversion into foodstuffs	450				
Domestic crop output required to produce imported foodstuffs:		Total consumption of food domestically produced	240	69	309
Direct vegetable foodstuffs	30				
Feedstuffs on the basis of domestic ratio of 7:1[2]	45	Consumption of imported vegetable foodstuffs	30		
Feedstuffs for draft animals required for additional home production	10	Consumption of animal foods imported or converted from imported feeds		6.5	
Allowance for seed, losses, and waste for additional home production	10				
Total	95	Total consumption of imported foodstuffs	30	6.5	36.5
Total domestic agricultural production of foodstuffs and feedstuffs required for complete self-sufficiency	995	Total consumption of all foodstuffs	270	75.5	345.5
Degree of self-sufficiency	[3] 90%	Degree of self-sufficiency			[3] 90%

[1] Conversion ratio: 7 feed calories to 1 food calorie.

[2] The actual ratio of feed calories imported to food calories produced therefrom is only 5:1 because of the greater feeding efficiency of the average composition of imported feeds as against that of domestically produced feedstuffs.

[3] The identity of the two percentages for degree of self-sufficiency is not a tautology in the sense that the two sets of calculations use the same data but only develop them from the production and consumption sides, respectively. This identity is rather due to a considerable similarity in the composition, as between vegetable and animal origin, of the foods domestically produced and imported. In extreme conditions a considerable divergence would be found in the results of the two methods of calculating self-sufficiency. For example, for a given composition of food consumption, the greater the domestic production of vegetable foodstuffs in relation to that of animal foodstuffs, and the greater the imports of animal foodstuffs (and feedstuffs) in relation to those of vegetable foodstuffs, the greater will be the difference between the (lower) degree of self-sufficiency calculated on the basis of the "production approach," and the (higher) degree of self-sufficiency calculated by the "consumption approach." It is easy to see that this difference arises from the loss of calories in the conversion of feeds into foodstuffs. The consumption approach ignores this loss because it evaluates imports of livestock products and feedstuffs in terms of the food calories ultimately obtained from them. The production approach, on the other hand, throws into the scales the full weight of the calories that would have to be additionally produced at home in the form of feedstuffs if all imports of livestock products and feedstuffs were to be eliminated.

COMPOSITION OF CONTINENTAL EUROPEAN DIET

As to the composition of the continental diet, it may be said that fully 78 percent consisted of foodstuffs of vegetable origin and only 22 percent of foodstuffs of animal origin (table 3). There is a wide variation, however, as among countries. For Germany this proportion may be estimated to have been two-thirds and one-third; for the Scandinavian countries and Holland even higher in animal foods and for southern and eastern Europe below the average.

Cereals and potatoes, according to the estimates, accounted for 54 percent of total calorie consumption,[2] sugar for about 7 percent, and fruits, vegetables (other than potatoes), and legumes for about 6 percent. Fresh-milk consumption provided about 6 percent of the total calories (in Germany 8 percent), and meat 5.7 percent (in Denmark 10 percent, in Italy 4 percent). Fats and oils accounted for 14½ percent of the total calorie intake on the continent (in Denmark 22 percent, in Italy 10 percent, and still less in southeastern Europe).

While actual distribution by countries varied a great deal, pre-war domestic and imported food supplies in continental Europe sufficed to give the people a diet with over 11 percent of the total calories supplied by protein, about 25 percent by fat, and over 60 percent by carbohydrate. These are the proportions of a fairly well-balanced diet, which, however, would require modification depending upon the physical characteristics of the various peoples and the natural and social environment in which they live.

CONCLUSION

The analysis of pre-war production and consumption of food on the continent of Europe has shown a high degree of continental self-sufficiency. It appears that the continent as a whole was less dependent on supplies from overseas than was commonly assumed. Only about 10 percent of the food calories consumed were imported, either direct or in the form of feedstuffs.

As has been indicated in the introductory statement, the analysis should provide some basis for a quantitative appraisal of the repercussions that changes in agricultural production on the continent or in nearby supply areas or changes in the continental diet might have upon the world's agricultural markets. Thus we may find that the dietary shifts required for a substantial reduction in the continent's import surplus of foodstuffs and feedstuffs would not be as drastic as is sometimes assumed. Given pre-war levels of production and population numbers, a 10-percent increase in continental European crop production, as we have seen before, would have made the continent self-sufficient without any change in the composition of its diet. Should a lower rate of population growth prevail and a moderate post-war increase in agricultural production be achieved, even a small change in the continental diet, from a pre-war ratio of 78:22 in calories from vegetable and animal sources, respectively, to a proportion of, say, 80:20, would substantially reduce the continent's normal dependence on outside supplies. This example may also serve as an illustration of the considerable reserve potential of food self-sufficiency that exists in areas of diversified agriculture having a sizable proportion of animal-food consumption. In

[2] This figure compares well with a weighted average of the estimates for individual countries given by Bennett. See p. 73 of BENNETT, M. K. WHEAT IN NATIONAL DIETS. Stanford Univ. Food Res. Inst. Wheat Studies 18, pp. 37-75, illus. 1941.

times of emergency even a moderate change-over to vegetable foods would help to lessen food difficulties, and this is precisely what has been under way in continental Europe since the outbreak of war. Other areas, such as India and China, which rely almost exclusively on the production and consumption of vegetable foods, do not possess this reserve potential, and food difficulties there easily assume famine proportions.

With progress in the agricultural development of nearby supply regions, reduced dependence of continental Europe on extraregional supplies might even be compatible with a pre-war rate of increase in continental population. There also remains a considerable domestic food reserve in the production of feed for draft animals, part of which is gradually being made available by continued mechanization of farm power. Such a shift, of course, makes food self-sufficiency increasingly dependent on motor-fuel supplies.

On the other hand, a more liberal and more prosperous economic regime in the world at large might reduce agricultural production or raise food requirements in European countries so as to increase the continent's food deficit by a substantial margin. It may be calculated that, in a situation such as existed in the thirties, a change in the continental diet toward increased consumption of meat from an average of 5.7 percent of total calories to, say, even 7 percent would have been equivalent to an additional need of 2½ million tons of meat. (The pre-war percentage in the United Kingdom was 18; in Germany, 9.) If this quantity had been produced domestically as pork from imported feeds, it would have required an importation of over 12 million tons of feed grain in addition to the 5 million tons actually imported. Because of the great loss of calories involved in the conversion of feed, a probable offsetting reduction in the consumption (and imports) of bread and potato calories would have amounted to only about 1.3 million tons of bread-grain equivalent.

Or, under the assumption that at the end of this war production of fats and oils on the continent will have fallen from 3.8 million to a little over 3 million metric tons, net shipments of fats and oils to continental Europe for a year or so would have to reach 2½ million metric tons, or 50 percent more than before the war, if consumption were immediately restored to pre-war levels.

§

YERBA MATÉ. . . . .

By Louis C. Nolan and Julia L. Wooster*

War in the East has interfered with the movement of tea to western importing countries. This development has stimulated interest in yerba maté, used for centuries as a beverage in South America. Consumption of yerba maté outside of South America has never reached such proportions as to result in exports of great economic significance to the producing countries. The diminution in tea supplies in the United States, however, has increased consumer interest in maté. Such a development may be of importance in the program to expand the trade of the United States with the other American republics.

No one knows how long maté has been used in South America. Wild maté trees were growing in eastern Paraguay, southern Brazil, and northeastern Argentina when Spanish Jesuit missionaries settled there early in the seventeenth century, and the natives were reported to be using a beverage made from the maté leaves. The Jesuits in time came to appreciate the good qualities of maté *(6)*.[1] They were given a legal monopoly of its production and were the first to cultivate it. They established plantations in the Paraguayan Province of Guairá and subsequently in the Argentine Territory of Misiones, along the upper reaches of the Uruguay River. A grove of no less than 20,000 trees once stood at Santiago, Paraguay, as a tribute to their success *(3, p. 29)*.

Long before the Jesuits were expelled from South America in the last half of the eighteenth century, leaving their cultivated plantations to decay and disappear, the maté industry had grown to be of substantial size and importance. From then until about 1900, however, when cultivation again was undertaken in Misiones, the trade was supplied from the natural forests of Paraguay and southern Brazil.

Until about the turn of the century, Brazil and Paraguay shared the world production between them, the former producing by far the larger share. In 1903, however, Argentina entered the picture and, until 1938, increased its production nearly every year. This expansion of Argentine plantation production reacted more unfavorably upon the Brazilian than upon the Paraguayan industry, since the latter is relatively small in volume and is in great demand for blending with the cultivated Argentine product. From 1926 to 1937, for example, Paraguay's annual share of world production remained fairly constant at 6 to 8 percent, rising to 11 percent in 1936. As Brazil's share declined from about four-fifths to two-fifths, Argentina's rose from a tenth to a half of the total. In 1938, the last year for which complete figures are available, with Paraguay's share still about the same, the production-control program in Argentina took effect, and the Argentine share of world production dropped to only two-fifths of the total. That of Brazil again rose to slightly more than half. Assuming that

* Office of Foreign Agricultural Relations.

[1] Italic numbers in parentheses refer to Literature Cited, p. 319.

each of these Governments in the years just ahead follows about the same general policy toward the maté industry as it pursued during the last half of the 1930's, Brazil should continue to contribute about half or slightly more of the world's production.

NATURE AND HABITAT

Maté and holly are kinsfolk, both trees belonging to the genus *Ilex* of the family Aquifoliaceae. *Ilex paraguariensis* is the species now generally recognized as best for making tea. It is found from Bolivia and Mato Grosso, Brazil, (at about 18° south latitude) to northern Uruguay and the Argentine Province of Corrientes (at about 30° south latitude). The most important commercial stands are located in eastern Paraguay, southern Brazil (southern Mato Grosso, central and western Paraná, western Santa Catharina, and northwestern Rio Grande do Sul), and the Argentine Territory of Misiones and the Province of Corrientes.

The maté tree is an evergreen. Under the best natural forest conditions it sometimes grows to be 80 to 100 feet tall and 2 to 2½ feet in diameter at approximately 40 inches from the base. More often than not, however, especially on cultivated plantations, it varies from about 12 to 30 feet in height. In general appearance it is bushy and resembles an orange tree *(7, 59T)*.

The maté tree grows in stands, frequently hiding beneath the shade of the Paraná pine. It seems naturally to prefer damp humid areas and depressions in the foothills and mountains at altitudes ranging from 1,500 to 2,500 feet above sea level. It is not ordinarily found along river bottoms, but up and away from them at distances ranging from 10 to 30 miles. When cultivated and exposed to the open air and sunlight, as in Argentina, it apparently is more susceptible to attack by insects and diseases.

The maté trees, according to Legros *(7, p. 60T)*-

> invariably prefer deep and permeable soil on a slope, as for example in fairly shallow hollows and ravines. The most suitable is that formed by fluvial sediments and alluvial soil, which retain sufficient moisture for vegetation.
>
> * * * the maté is found growing wild or is planted in clay soils covered with a stratum of black humus and only slightly acid soil, generally containing fertilizing substances in normal proportions.
>
> Very compact soil of normal composition, such as sand-clay, sand-clay-humus, chalk-clay soils and soils formed from the disintegration of gneiss and feldspar also permit a hardy growth.
>
> The most suitable soils are those which have at one time been forested and contain a deep layer of humus that has partially lost the acidity caused by the active decomposition of organic matter.

THE MATÉ INDUSTRY

In Brazil, though there are some plantations and semicultivated trees, most of the maté comes from wild forests. In Paraguay such natural growths have been supplemented with some plantation cultivation. In Argentina plantation cultivation is dominant.

New plants may be secured from grafts, cuttings, layers, seedlings, or directly from seed. Reproduction by grafting necessitates experienced workmen and is not the most common method used. Propagation by cuttings has not proved entirely satisfactory. Reproduction by layers may be promoted, generally in the winter or early spring, by bending and partially burying the new shoots that develop from the sides of the mature plants, with the proper sort of cutting at harvesttime. When a sufficient number of seedlings are available, they may be transplanted to nurseries at 2 or 3 years of age, provided they are handled carefully, reset immediately, and left with the original earth attached to their roots. Under these conditions the plants usually multiply well in the proper environment. One of the major problems in maté cultivation has been that of securing seedlings.

Reproduction by seed nowadays is regarded as "a very easy, sure, and economical method" *(7, p. 60T)*. For a long time, however, it was believed that the seed, because of its tough epidermis and gelatinelike coating, would not sprout until eaten by birds. The seeds are now planted as soon as they mature before their epidermis hardens or are immersed in water or acid solutions to soften or break down the outer covering.

The plants are sprouted in seedbeds. When they reach a height ranging from 12 to 20 inches - sometimes 18 months or longer - they are taken to the field and planted in rows. This transplanting is done chiefly in winter when little plant development is going on. The distances between plants vary considerably, depending upon a number of factors, such as the fertility of the soil. Rich soil necessitates greater distance between plants than poor soil. They are commonly set from 10 to 15 feet apart. Once the young trees are planted, they should be protected from the sun. They must be protected also from weeds and brush, as much of the cultivated maté (more than two-thirds in Argentina) is grown on land as wooded as it was in its native state.

Young trees are pruned every year to give them the proper shape, but harvesting proper (cutting the branches) does not ordinarily begin until the trees are 4 or 5 years old. From then on it may be done yearly, biennially, or triennially, without materially affecting the volume of the total production. If it is done oftener than every other year, however, the tree may be injured permanently and be short-lived.

Whether the trees are wild or cultivated, harvesting is much the same. It should be limited to the fall and winter months when the tree is dormant and to the time of day when the leaves are dry. It is done by means of a machete or sickle, used with an upward and outward blow to sever the branch from the tree. In this way the wound is better protected from the action of the weather and the direct sunlight. Only the small branches with leaves should be cut; but, because longer branches are easier to toast over the fire, they are frequently cut, to the injury of the tree. On the plantations in Argentina, perhaps three-fourths of the leaves and foliage are removed.

Once the branches have been cut from the trees and gathered in huge piles, the operator builds a bonfire and a log barrier to protect him from the fire while he toasts the leaves. Standing behind this barrier, he holds the branches out over the fire for a few seconds, turning them constantly until the green leaves are toasted uniformly without being burned. The short branches bearing the leaves are then broken from the long branches and made ready for drying.

The barbacuá is most frequently used in drying, although more primitive or more modern methods may be used. It is described by Cameron *(4, pp. 994-995)*[2] as consisting-

merely of a low dome made by planting poles in the ground and bending them over, or by arching poles over a low inclosure of any material, the whole being roofed * * * The loose branches of the broken maté are then placed upon the top and sides of this dome-shaped structure [but underneath the roof] so as to cover it completely and retain the hot air, conducted to the center of the *barbacuá* through a subterranean canal from the fire built below and some distance away. During the drying process, in order to assure uniform desiccation, the branches of maté are turned over by means of a long pole wielded by a workman perched on top * * * From 5 to 15 hours are required to complete the process.

Some barbacuás, so-called, now are made with brick, cement, or tile chambers (Hunter)[3]-

containing iron pipes through which heat is carried from a huge furnace. The ceiling of the chamber is almost directly over the hot pipes and on this ceiling or roof nets are spread on which are deposited the withered leaves. Laborers keep the leaves stirred so that all are subjected to proper heating.

[2] Condensed from CAMERON, C. R. THE MATÉ INDUSTRY. U. S. Cons. Rpt., 63 pp., illus. São Paulo, Brazil. June 25, 1929. [Typewritten.]

[3] HUNTER, WINIFRED A. YERBA MATÉ PROBLEM IN ARGENTINA - OFFICIAL AND PRIVATE EFFORTS TO DEVELOP AND EXTEND FOREIGN MARKETS. U. S. Cons. Rpt., 42 pp. Buenos Aires. Nov. 3, 1936. [Typewritten.]

Mechanical methods of curing also have been developed, as a more uniform quality of product is thought to be secured thereby.

Once thoroughly dried, the leaves are taken to a threshing floor and beaten until they are separated from the small branches. This separation also can be done by the modern mechanical process of trituration. The residue, consisting of a mass of leaves, twigs, bark, etc., is maté canchada. It was originally used for tea making without further refinement. Today before entering regular channels of consumption it goes through a milling process. It is again dried for protection against mold. Smoke may be used to produce a desired flavor or to bring out the aroma and quality of the maté itself. It is also put through blowers and sifting machines to purify it and to separate it into different grades as to size, from a coarse to a powder-fine article.

Since different areas produce maté possessing distinctive qualities, the manufacturing process also involves blending different varieties, bearing in mind their origin (forest, semicultivated trees, or plantation) and the manner in which they were toasted, dried, aged, etc. The proper aging of crude maté improves its aroma and flavor. Maté may be purchased in a variety of mixtures, grades, and blends to suit a multiplicity of tastes. The brands are about as significant as those of tea or coffee. In 1936 approximately eighty-five popular brands of maté were on the market.[4]

Like tea from the Far East, maté is prepared for drinking by pouring boiling water upon the leaves and allowing it to steep. In the rural sections of South America, the heaviest consuming centers, it is made and drunk in traditional fashion. The vessel in which the infusion is made and from which it is drunk is called a cuia. This is a small container made from a dried gourd, a cow's horn, or perhaps a coconut shell, with a round opening at the top 2 or 3 inches in circumference. It is filled about half full of maté.. Hot water is added. Without the addition of sugar or other ingredients, the beverage is sucked through a hollow tube, which usually has a metal strainer on the lower end, sometimes fan-shaped. The cuia is often refilled from 5 to 10 times, the same leaves being used. The third, fourth, and fifth refills frequently are considered the best drink. To offer the traveler a drink of maté upon arrival is one of the very old traditions in the rural maté-drinking sections of South America *(3, p. 102)*. Made in the most modern manner, maté is prepared and consumed precisely as is tea. It may be taken hot or iced and with sugar, lemon, or cream added. Generally speaking, 2-2/3 to 3-1/3 ounces of leaves make a gallon of good maté tea.

WORLD PRODUCTION AND CONSUMPTION

Brazil, Argentina, and Paraguay are the only countries of the world that produce maté commercially. Production from these three countries from 1927 to 1937 increased from about 279 million pounds to 485 million pounds. After this time it declined markedly because of the inauguration of production-control measures in Argentina.

Maté is classified as to quality, strength, and aroma in the following order, according to Dr. Enrique Bordenave *(2, p. 853)*, former Minister of Paraguay to the United States: Paraguayan, Mato Grosso (Brazil), Misiones (Argentina), Paraná (Brazil), Santa Catharina (Brazil), and Rio Grande (Brazil). The formulas for the commercial grades established by the Argentine Ministry of Agriculture *(2, p. 853)* are for Extra - a blend of 50 percent Paraguayan, 30 percent Argentinean, and 20 percent Brazilian; for Good - a blend of 50 percent Argentinean, 20 percent Paraguayan, 20 percent Brazilian

[4] See reference cited in footnote 3.

TABLE 1.– *World commercial production of yerba maté, 1926-40*

YEAR	BRAZIL	ARGENTINA	PARAGUAY	TOTAL
	1,000 pounds	*1,000 pounds*	*1,000 pounds*	*1,000 pounds*
1926	263,529	28,660	20,974	313,163
1927	223,690	35,715	19,601	279,006
1928	250,604	48,502	20,154	319,260
1929	280,869	50,706	22,057	353,632
1930	213,012	56,099	20,729	289,840
1931	225,870	84,891	22,630	333,391
1932	218,277	112,733	20,734	351,744
1933	175,457	112,495	24,015	311,967
1934	190,748	140,819	28,032	359,599
1935	184,185	166,144	30,975	381,304
1936	196,822	177,364	45,144	419,330
1937	211,575	234,418	39,330	485,323
1938	208,200	159,197	31,780	399,177
1939	211,707	142,928	-	-
1940	-	151,434	-	-

from Paraná, and 10 percent Brazilian from Rio Grande do Sul; and for Inferior - a blend of all Brazilian, 80 percent from Rio Grande do Sul and 20 percent from Paraná.

Argentina in 1939 had 66 maté mills in operation, 21 in the Federal capital, 21 in the Territory of Misiones, 11 in the Province of Santa Fé, 4 in Corrientes, 3 in Córdoba, 2 each in the Chaco and the Province of Buenos Aires, and 1 each in the Province of Entre Rios and the Territory of Formosa. A number of these mills, notably those in Misiones, Buenos Aires, and Rosario, are modern fireproof structures, four to six stories high, built of reenforced concrete. They have modern research laboratories for testing the raw and the finished product, up-to-date offices, modern machinery for weighing, sifting, grinding, grading, pressing, sacking, loading, unloading, and sealing the cans containing the finished product. Brazil in 1940 had 31 maté mills - 16 in Paraná, 8 in Rio Grande do Sul, and 7 in Santa Catharina. Paraguay has only a few mills.

Accurate and comparable figures on world consumption of maté are not available. Outside of Latin America, maté is hardly used at all. In Latin America its use is confined largely to the producing countries and their next-door neighbors, notably Uruguay and Chile. Argentina is the largest consumer in the world. During the 4-year period 1936-39, consumption of the milled product in that country rose from 218 million pounds (milled) to 242 million pounds. It averaged about 229 million pounds yearly for the entire 1936-40 period, or 17.9 pounds per capita *(1, pp. 22-27)*.

Brazilian production during the last 6 years for which figures are available (1934-39), exceeded exports by an average amount of 58 million pounds annually. This excess evidenced a decided tendency to increase throughout the period from about 33 million pounds in 1934 to 79 million pounds in 1939. How much of this actually moved into consumption in Brazil is impossible to say. In Paraguay, production in excess of exports rose from about 18 million pounds in 1933 to 39 million pounds in 1936 but by 1938, the last year for which figures are available, it had slumped to 22 million pounds, averaging during this 6-year period (1933-38) 26 million pounds yearly.

Uruguay and Chile are the only other two Latin American countries known to consume substantial quantities of maté. Net imports into Uruguay during the last 4 years for which figures are available (1936-39) averaged 46 million pounds yearly. Imports into Chile during the 5-year period (1936-40) averaged 18 million pounds annually.

Spasmodic efforts have been made from time to time to promote consumption in Europe and the United States, but these efforts have met with little lasting success.

In the United States consumption of the ground product - measured by imports - rose from about 14,720 pounds in 1931 to 442,149 pounds in 1935, following an active maté advertising campaign. By 1940 it was down to 82,763 pounds, the lowest point since 1932. Compared with consumption of tea in the United States, imports of which in the last half of the 1930's averaged about 88½ million pounds yearly, this consumption of maté is insignificant.

By 1936 or 1937, total world consumption of maté probably amounted to a figure ranging from 330 million to 440 million pounds yearly. This was substantially less than current world production.

TABLE 2.—*Imports of yerba maté (ground)*[1] *into the United States, 1931-40*

YEAR	ARGENTINA		BRAZIL		PARAGUAY		TOTAL	
	QUANTITY	VALUE	QUANTITY	VALUE	QUANTITY	VALUE	QUANTITY	VALUE
	Pounds	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*
1931	8,660	1,585	4,913	297	-	-	[2] 14,720	[2] 1,977
1932	24,996	3,876	11,653	805	-	-	[2] 38,876	[2] 4,799
1933	59,858	6,703	50,568	2,966	3,470	140	[2] 124,425	[2] 10,390
1934	209,061	16,969	81,028	3,988	5,630	260	[2] 309,451	[2] 22,185
1935	308,158	25,630	99,483	4,005	12,023	1,200	[2] 422,149	[2] 31,013
1936	38,757	3,764	107,726	5,043	158,211	5,078	304,694	13,885
1937	41,053	4,078	45,966	1,849	-	-	87,019	5,927
1938	68,307	6,464	42,533	1,536	-	-	110,840	8,000
1939	23,297	2,794	75,387	3,847	3,798	325	102,482	6,966
1940	15,268	1,790	63,231	3,488	4,264	630	82,763	5,908

[1] In addition to these imports of the ground dutiable product, 3,316 pounds of the crude product, valued at $306, were imported in 1931, and 16,265 pounds, valued at $1,465, were imported in 1932.

[2] Includes imports through Germany.

THE BEVERAGE MATÉ

Many people believe that maté as a beverage deserves the favorable consideration of American consumers in about the same way that tea or coffee deserves it, and for the same general reasons. Maté is of particular interest at this time when a shortage of tea may be in the offing. In taste, maté is thought to compare favorably with tea. Like tea, maté has a somewhat bitter taste, and, as with most beverages that come to be used habitually, a liking for it often has to be acquired.

Chemical analyses of different samples of maté leaves vary considerably, depending upon a number of factors. The analysis made by Gustave Peckolt (table 3), a German botanist, chemist, and pharmacist who lived for a number of years in Brazil, illustrates, on an average, the most important chemical components of maté as compared with those of tea and coffee.

TABLE 3.—*Principal chemical constituents of tea, coffee, and maté*

SUBSTANCE	GREEN TEA	BLACK TEA	COFFEE	MATÉ
	Percent	*Percent*	*Percent*	*Percent*
Essential oil	0.79	0.60	0.041	0.001
Chlorophyll	2.22	1.814	1.366	6.20
Resin	2.22	3.64	1.669	2.07
Tannin	17.80	12.88	1.639	1.228
Theine, mateine, or caffeine	0.45	0.43	0.266	0.25
Extracts (Materias extractivas)	46.40	3.90	27.067	23.088
Cellulose and fiber	18.58	28.32	17.88	18.00
Ashes	8.56	2.56	2.56	3.81

Sananiego, *(8, p. 72)*. Sananiego's work contains a number of other analyses as well. See also Bordenave *(2, p. 849)*.

Maté should cost the United States consumer only a fraction of the price of tea. According to an analysis written jointly by Carlos Garcia, commercial attaché of the Argentine Embassy at Washington, and Newton T. da Silva Carneiro, United States representative of the National Matte Institute of Brazil *(5, pp. 13-14)*, the cost of a cup of maté is only about a fourth that of a cup of coffee and about half that of a cup of tea. In 1939 the declared value of all tea imported into the United States averaged between 21 and 22 cents a pound. That of coffee and maté each averaged less than 7 cents a pound.

All United States imports of tea from the Far East may be completely shut off for the duration of the emergency, making tea costly or impossible to buy. Should United States consumption of maté increase materially in the near future as a result of any one or a combination of the above factors, it would help to solve a problem of overproduction in Latin America and be yet another step forward in the direction of hemispheric self-sufficiency.

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THE FRUIT INDUSTRY OF ARGENTINA, by Fred A. Motz. Foreign Agriculture Report No. 1.

Argentina leads in the production of deciduous fruit in South America. Pears, apples, and grapes prior to the war were exported in large quantities and became well established in many world markets. Grapes have been produced commercially since colonial days, but the apple and pear industries are developments of the past decade. A net importer of considerable quantities of these fruits in the early thirties, Argentina in 1939 made net exports of half a million boxes of apples and nearly a million and a half boxes of pears. High-grade fruit for export is produced under irrigation in the Río Negro Valley and in the Mendoza-San Juan regions. Both deciduous and citrus fruit for the domestic market is grown in eastern Argentina, largely in the Paraná Delta.

THE FRUIT INDUSTRY OF BRAZIL, by Fred A. Motz. Foreign Agriculture Report No. 2.

Though Brazil produces all kinds of fruit, production for export is limited mainly to such tropical fruits as pineapples, bananas, and the citrus fruits, particularly oranges and grapefruit. As in Argentina, in Brazil the export fruit industry has been largely a development of the past 10 years. Whereas exports of oranges totaled 2½ million boxes and of grapefruit 22,000 boxes in 1932, by 1937 they had reached 5½ million and 259,000, respectively. Argentine and European markets were the principal outlets for Brazilian citrus fruit. In the latter they competed with oranges and grapefruit from California during the summer months. There is still much good fruit land available for development in Brazil. Given remunerative markets, the rapid expansion of the thirties could easily be duplicated.

THE FRUIT INDUSTRY OF CHILE, by Fred A. Motz. Foreign Agriculture Report No. 3.

Chile follows Argentina as a Latin American producer of deciduous fruits. A wide variety is produced - stone fruits and table grapes in the north, pears, wine grapes, and melons in the Central Valley, and apples in the south. Chilean melons, grapes, and wine have won a deservedly high reputation in many foreign markets, among them the United States, which even before the war received more than half the annual exports of grapes and most of the exports of melons. Suitable land for fruit growing is much more limited in Chile than in the other two exporting countries, but considerable increase in production of most fruits would doubtless follow any improvement in demand.

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